PATENT COOPERATION TREATY

PCT

REC'D 11 JAN 2002
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P402WO	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/03242	International filing date *(day/month/year)* 21/08/2000	Priority date *(day/month/year)* 21/08/1999
International Patent Classification (IPC) or national classification and IPC H01J9/02		
Applicant PRINTABLE FIELD EMITTERS LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16/03/2001	08.01.2002
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Gols, J Telephone No. +49 89 2399 2616

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03242

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-5,9-22	as originally filed			
6,8	as received on	06/12/2001	with letter of	29/11/2001
7	with telefax of	20/12/2001		

Claims, No.:

4-49	as originally filed	
1-3	with telefax of	20/12/2001

Drawings, sheets:

1/8-8/8	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   ☐ the language of publication of the international application (under Rule 48.3(b)).
   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.
   ☐ filed together with the international application in computer readable form.
   ☐ furnished subsequently to this Authority in written form.
   ☐ furnished subsequently to this Authority in computer readable form.
   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   ☐ The statement that the information recorded in computer readable form is identical to the written sequence

listing has been furnished.

4. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 32-49.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 32,33,49 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.
☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-31
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-31
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-31
	No:	Claims	

2. Citations and explanations
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

III

1. Independent claim 33:

   This claim is directed to a field electron emitter created by a method according to any one of the preceding claims.

   It is noted that these preceding or previous claims relate to a method of creating a composite broad area field electron emitter within an electrode structure that is at least partly preformed. Consequently it cannot be understood what kind of field electron emitter is meant in claim 33. A method for creating a field electron emitter proper has not been defined. Furthermore, claim 33 has been defined as a product (broad area field electron emitter) of a process, without clearly defining the product features. Consequently it is not possible to provide a meaningful opinion on claim 33.

2. Independent claims 32 and 49 contain a reference to the description and the drawings which prevents a clear interpretation of the claims.

3. Claims 34 - 48

   These claims are depending on claims 33. Since claim 33 is not clear, claims 34 - 48 are not clear as well.

4. It has been noted in his letter of reply dated 29.11.01, that the applicant reserves his position and will amend the above-mentioned claims during subsequent national and regional phases, in accordance with local requirements. Consequently, the examiner will provide an examination on the basis of amended claims in the regional phase accordingly.

V

1. Reference is made to the following documents:

D1: EP-A-0 932 180
D2: FR-A-2 723 255
D3: GB-A-2 304 989

2. Claim 1:

a. D1 discloses a method of creating a composite broad area field electron emitter within an electrode structure that is at least partly preformed, the method comprising the steps of:

a) providing a masking layer (31) on selected areas of said electrode structure, to define masked areas and unmasked areas of said electrode structure;

b) after step a), applying at least a first particulate constituent mixed and a second constituent to said unmasked areas of said electrode structure, such that particles of said first constituent are selectively directed towards desired locations of said unmasked areas; and after step b):

c) removing said masking layer from said selected areas, together with any stray quantities of said constituents on said masking layer; and

d) processing said constituents to create broad area field electron emission material having sites in said desired locations of said electrode structure (see column 20, line 45 - column 22, line 58).

The subject-matter of claim 1 differs from what has been disclosed in D1 in that in step b) particles of said first constituent are selectively directed towards desired locations within said unmasked areas, thereby avoiding other locations of said unmasked areas.

This feature relates to the problem of preventing the deposition of particles in unwanted areas within the unmasked areas.

In D1 the particles together with the second constituent (binder) are directed to all parts of the unmasked areas. After step b) the binder is removed whereby the

particles are directly adhered to the unmasked areas by Van der Waals force. In the present invention only the particles are directed towards the location within the unmasked areas out if the second constituent. Consequently in step b) the particles are separated from the second constituent and directed to the selected locations in the unmasked areas. This is neither taught in D1 nor the remaining documents D2 and D3. Consequently claim 1 meets the requirements of Articles 33(2) - (4) EPC.

2. Claims: 2- 31

These dependent claims are related to embodiments of the invention as set out in the independent claim and as such meet the requirements of Article 33(2) - (4) PCT.

VIII

1. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

containing diamond particles is forced into the empty emitter cells 304 using a squeegee 306. The filled assembly is fired to 1080°C in a reducing atmosphere to evaporate the binder and form a compact 320, as shown in Figure 3b of the accompanying diagrammatic drawings, with good electrical and mechanical contact between the diamond and the silicon. Nickel may be added to the paste to facilitate electrical contact. The final assembly is plasma treated and then caesiated to reduce the electron affinity. Geis states that although this structure emits well, there is a very large gate current. Figure 3c of the accompanying diagrammatic drawings shows that this is likely to be caused by both current flow through the compact and emission direct to the gate 334 when voltages 332 and 331 are applied to the gate 303 and anode 330 respectively. Such spurious currents can be large compared to the desired emitted current 333. It is our view that this outcome is inevitable with this approach since the diamond particles tend to cling to the sidewalls of the emitter cells. Another problem is emitting debris 335 being left on top of the gate where it will produce uncontrolled currents 336. Passing mention is made of the use of spray or electrophoretic deposition but no details are given.

Danroc (*US Patent 5,836,796*) describes the use of electrophoresis to coat microtip emitters with fine diamond particle emitters to enhance emission. A metal additive deposited by electroplating is used to provide good electrical contact between the diamond and the metal microtip. Danroc is concerned only with microtip emitters.

Jin *(US Patent 5,811,916)* is concerned with field emission displays using a very specific type of diamond material. Jin mentions in passing the use of electrophoresis to dispose particles of this material, which is an emitting material *per se*, on a substrate, but no details are given.

Preferred embodiments of the present invention aim to provide improved field emitting structures wherein a particulate-containing composite field electron

emitter is made *in situ* within a previously fabricated electrode structure. Said process preferably includes the use of electrophoresis to optimally locate the particles within the electrode structure. The emitter structures may be used in devices that include: field electron emission display panels; high power pulse devices such as electron MASERS and gyrotrons; crossed-field microwave tubes such as CFAs; linear beam tubes such as klystrons; flash x-ray tubes; triggered spark gaps and related devices; broad area x-ray sources for sterilisation; vacuum gauges; ion thrusters for space vehicles; particle accelerators; lamps; ozonisers; and plasma reactors.

According to one aspect of the present invention, there is provided a method of creating a composite broad area field electron emitter within an electrode structure that is at least partly preformed, the method comprising the steps of:

a) providing a masking layer on selected areas of said electrode structure, to define masked areas and unmasked areas of said electrode structure;

b) after step a), applying at least a first particulate constituent and a second constituent to said unmasked areas of said electrode structure, such that particles of said first constituent are selectively directed towards desired locations of said unmasked areas; and

after step b):

c) removing said masking layer from said selected areas, together with any stray quantities of said constituents on said masking layer; and

d) processing said constituents to create broad area field electron emission sites in said desired locations of said electrode structure.

Preferably, step d) is carried out after step c).

Said particles of material may be applied in step b) as a plurality of electrically conductive particles in a solution or colloidal dispersion of an electrically insulating material or a chemical precursor therefore, with the process of step d) resulting in said electrically conductive particles being coated in said electrically insulating material.

The process of step d) may include removing fugitive components of said solution or dispersion.

A liquid component of said solution or dispersion may have dissolved in it a chemical precursor for said electrically insulating material, and the method may comprises decomposing said precursor by heat, ultra-violet light or other means to form said electrically insulating material.

Said precursor may be in the form of a sol-gel.

Said precursor may comprise a soluble polymer.

Said particles may comprise electrically conductive particles pre-coated with an electrically insulating material.

Said electrically insulating material may comprise silica.

Step (b) may comprise spray applying said first and second constituents onto said selected areas of said electrode structure, through apertures which are provided on said electrode structure and which direct said particles of said first constituent selectively towards said desired locations.

Said apertures may be defined by parts of said electrode structure which overlie recesses formed in said electrode structure, such that said first and second constituents are directed selectively towards the bottoms of said recesses rather than side walls thereof.

CLAIMS

1. A method of creating a composite broad area field electron emitter within an electrode structure that is at least partly preformed, the method comprising the steps of:

   a) providing a masking layer on selected areas of said electrode structure, to define masked areas and unmasked areas of said electrode structure;

   b) after step a), applying at least a first particulate constituent and a second constituent to said unmasked areas of said electrode structure, such that particles of said first constituent are selectively directed towards desired locations of said unmasked areas; and

   after step b):

   c) removing said masking layer from said selected areas, together with any stray quantities of said constituents on said masking layer; and

   d) processing said constituents to create broad area field electron emission sites in said desired locations of said electrode structure.

2. A method according to claim 1, wherein step d) is carried out after step c).

3. A method according to claim 1 or 2, wherein said particles of material are applied in step b) as a plurality of electrically conductive particles in a solution or colloidal dispersion of an electrically insulating material or a chemical precursor therefor and the process of step d) results in said electrically conductive particles being coated in said electrically insulating material.

PATENT COOPERATION TREATY

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
P402WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/03242	21/08/2000	21/08/1999
Applicant		
PRINTABLE FIELD EMITTERS LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 4a

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/03242

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 932 180 A (SONY CORP) 28 July 1999 (1999-07-28) column 20, line 45- -column 22, line 36; claims 9-20	1,18,19, 24, 33-35, 37,40, 47,49
A	FR 2 723 255 A (SAMSUNG DISPLAY DEVICES CO LTD) 2 February 1996 (1996-02-02) claim 1	1
P,A	EP 0 957 503 A (SONY CORP) 17 November 1999 (1999-11-17) claims 1-5	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 January 2001	17/01/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Van den Bulcke, E

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter[illegible]l Application No
PCT/GB 00/03242

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 304 989 A (TUCK RICHARD ALLAN ;LATHAM RODNEY VAUGHN (GB); TAYLOR WILLIAM (GB)) 26 March 1997 (1997-03-26) cited in the application claims 21-31	1
A	GB 772 449 A (CHEMELEX CORPORATION) 10 April 1954 (1954-04-10) claims 1-13	1,3,9, 18,19
A	GB 1 034 526 A (CHEMELEX) 29 June 1966 (1966-06-29) claim 1	1,3,9, 18,19

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/03242

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0932180	A	28-07-1999	JP 11213866	A	06-08-1999
FR 2723255	A	02-02-1996	JP 8055574	A	27-02-1996
			US 5505649	A	09-04-1996
EP 0957503	A	17-11-1999	JP 11329217	A	30-11-1999
			US 6116975	A	12-09-2000
GB 2304989	A	26-03-1997	AU 6626096	A	05-03-1997
			CN 1192288	A	02-09-1998
			DE 69607356	D	27-04-2000
			DE 69607356	T	07-12-2000
			EP 0842526	A	20-05-1998
			ES 2146890	T	16-08-2000
			WO 9706549	A	20-02-1997
			GB 2306246	A,B	30-04-1997
			JP 11510307	T	07-09-1999
			US 6097139	A	01-08-2000
GB 772449	A		NONE		
GB 1034526	A		NONE		

F ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 21 June 2001 (21.06.01)	
International application No. PCT/GB00/03242	**Applicant's or agent's file reference** P402WO
International filing date (day/month/year) 21 August 2000 (21.08.00)	**Priority date** (day/month/year) 21 August 1999 (21.08.99)
Applicant TUCK, Richard, Allan	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

16 March 2001 (16.03.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Olivia TEFY

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